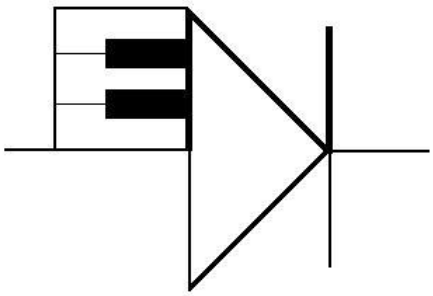

ELECTRONOTES

WEBNOTE 40 5/6/2016

ENWN-40

CURRENT VIEW OF MY VIEW OF "THE HUM"

We should hold any "opinion" held by a scientist (professional or amateur) as suspect, until such time as it is truly found to be a "conclusion" based on scientific evidence. This is not a new idea on my part. A scientist usually has a general scientific training and often becomes an "expert" in a relatively small area of a particular discipline (not infrequency the ranking expert in a VERY small area, in which case, he/she may write it up for publication). Note well that the general scientific training is not, in the usual case, enough to allow one scientist to authoritatively "vet" (or not) the work of a better-placed expert. At the same time, the general training is often sufficient for one scientist to definitively dismiss as BS the "work" of a true crank, or at least to better frame an evaluation of an honest but disillusioned amateur. Such "debunking" efforts are likely to invoke a "ring of truth" to the scientifically trained**;** or a characterization as being part of the "they don't want you to know" crowd among those disposed to conspiracy theories. Many areas of public concern and curiosity are cases in between extremes. And you don't need to be scientifically trained to understand plain evidence [1].

Here we continue and summarize our discussion of "the Hum" [2-5]. When we say "the Hum" (uppercase H) we mean one quite specific, commonly occurring (that is - most usually found), instance of at least several hum-like phenomenon that appear in the media, often with a sensational presentation (like "Scientists are baffled!!!"). The Hum here refers to a familiar description commonly described as "a diesel engine idling in the distance". My impression (and personal experience) is that this Hum is first "heard"**;** then arouses our curiosity, and eventually, often our annoyance. In most cases, it comes "On" in the absence of other sounds, typically when lying in bed with no fan or refrigerator (etc.) running. Typically also it is omnipresent, although often ignored until it intrudes (as more interesting perceptions fade out), coming out of silence, or as we are reminded to listen. In today's generally noisy acoustic environment, such stimuli as the Hum (ostensibly mundane), may be acoustically "masked", or mindlessly disregarded as constant and meaningless (just your fridge running) or perfectly familiar (just a truck).

One problem is that when an individual first learns of the hum, or is asked if he/she hears it, they will listen, and likely hear something. Indeed it may be fashionable to reply in the affirmative (like a meme). The media has been quick to report an outbreak, of which they may be responsible for further promulgating!

There are reports (media and internet items) that are clearly NOT the Hum (at least not the diesel engine variety) but more mundane mechanical rumblings (quite temporary) such as distant and dispersed (in the acoustic senses where high frequencies are diminished and the arrival times of different frequency ranges are variable) traffic noise, as well as other non-explained sounds heard "from the sky" a few times. A few "rumbling" instances were investigated, and some measure of explanation reported. Other "scientific" explanations are clearly bogus, like "tinnitus" which is two orders of magnitude too high in pitch, and microseisms which are two orders of magnitude too low in pitch. Poor science writing does not help in this regard (like confusing the total duration of a tone with the duration of one "cycle" (the "period") of the tone).

Against this somewhat nebulous background – what is real evidence, and what does the evidence imply about origins of the Hum? Conclusions highlighted in RED below.

(1) PERSONAL DISCOVERY ON THE PART OF INDIVIDUALS

The encounter with the Hum likely comes as either an introduction by an acquaintance (including news reports) or simply by just "hearing" it. Let us first assume the one personally, and relatively suddenly, hears it. As a hearer of over 20 years duration, I remain astounded that everyone does not hear it – it is that clear. But at the same time, I am perfectly aware that, at least in cases like my own, I can (unconsciously) ignore it for years at a time. I kind of managed to ignore it for at least the better part of 20 years from the time I first heard it, investigated it, and then lost interest; up until a few months ago when Glen MacPherson was on the radio show ***Coast to Coast AM*** [2]. The show is one of only a few (two!) that play well on local radio in the early mornings (night!). I tune it in if the website indicates an interesting (token skeptic) guest like Bob Zimmerman, Michael Shermer, or Joe Nickell, etc. Glen sounded promising, and it was rewarding to hear what he had to say. BUT – in consequence, the Hum was back! My mind turned to it. It is there all the time it is sufficiently quiet – although I can ignore it.

Everyone who first "hears" the Hum is forgiven for hesitating to affirm detection. In the first place, it sounds like a truck engine (or some familiar machine). But it follows you - not louder here, softer there. If you ask others around you, many will say they hear nothing, as difficult as this is for a "hearer" to imagine. My wife does not hear it. Others who fail to hear anything live with more noise (kids, TV, etc.) It is easily masked – it won't interrupt a conversation or a favorite show – they will mask it. If you go outside,

likely it will be diminished or totally absent. Likely this is because there is quite a bit of noise outside most of the time, and I suspect, your distance cue (expectation) has a much larger range than just the walls inside. [I live a mile from Route 13, an uphill grind of several miles out of Ithaca, and real trucks are very common.] Occasionally I hear the Hum outside, but at about half-level or less. Eventually I suspect everyone looks and listens outside the window, and up/down the road. What a joke if it were a utility repair truck this time! (1a) So the first personal finding is that it does not seem to be something mundane, although it sounds like a non-alarming familiar machine.

Now, a very important finding is that the hearer has some control over the Hum. You can turn it off – although not for long. I estimate that it can turn off abruptly and then ramp back up after something like half a second. This is not long. Count "one thousand one, one thousand two…" and it is only half the "one thousand one". On the other hand, this would be long enough to be convincing were it not for the disruption of turning it off! How do you turn it off, by the way? One way is to make a brief grunt, throat clear, or speak a short syllable ("I"). Then you have to immediately concentrate on the Hum coming back on. One try is not enough. Do it 10 time and you will see that it is not a coincidence. Another way to turn it off is to shake your head vigorously for about a second and abruptly stop. I find that this avoids the distraction of actually making a sound, and seems to delay the ramping slightly. One is tempted also to try a continuous shaking (say 5 seconds) to see if the Hum goes off and stays off during the shaking. This takes some practice, but I think it does turn it off. Obviously this is not useful long term! But this tells us an important fact. (1b) You have personal control over the Hum and can interrupt it. This is very important, as it strongly suggests that either it is internal to yourself and can be reset, or that it involves a perceptual pathway (distant source, and propagation unknown) that can be interrupted at the receiver (which seems unlikely).

A third finding is that you can artificially create a close simulation of the Hum. This in indicative of the origin, and particularly useful for those who do not find themselves hearers. Most of us have stuck our fingers in our ears – for fun as kids and possibly to clean out an obstruction. When you do this (and you just did!) you hear a low rumbling. This is familiar, and is a pretty good approximation to what the Hum sounds like. However, an even better example of the Hum experience is to just lightly but completely plug ONE ear with an index finger. This has the dual effect of allowing a pathway to ambient sounds (like those naturally heard with the Hum), a lower level of Hum, and a controllable Hum. To control the level, gradually tighten up the three remaining fingers of your fist. The finding is that (1c) the Hum is remarkably like the spontaneous tremors that produce the rumble in a finger-blocked (personal) ear.

(2) HEARING LOW FEQUENCIES

The ear is truly remarkable in terms of frequency range (15 Hz to 20,000 Hz, a ratio of 1300, or over 10 octaves, a piano having just over 7 octaves) and a dynamic range of 120 db of sound-pressure level (a million to 1 from "threshold of pain!" down to threshold of (just barely) hearing. The Hum, if it was a physical acoustic vibration would be both low frequency (ballpark 50 Hz) and low (perceived) amplitude. The ear is NOT "flat" in its response. A frequency of say 50 Hz would have to be something like 100 times larger in amplitude to be heard as loud as a tone at 1000 Hz. (Look up "Fletcher-Munson" curves or "Equal Loudness" curves.) In addition, a tone of 1000 Hz (only 1/15th of the way to the top) is already high pitch (two octaves above middle C on the piano) because of the logarithmic nature of pitch (ratios matter). Further, the electric mains have a frequency of 60 Hz in the US, often 50 Hz elsewhere, so these are very low acoustically. We often hear it said that "power line hum" is 60 Hz and you can hear it as a "buzz". It is very difficult to hear 60 Hz. When one hears such power line noise it is mostly second harmonic (120 Hz) generated by power supplies. Touch an audio input center pin with a finger (as is often done as a test) and that is what we mean. If you accidently record this as audio, you can filter out 60 Hz to little avail as it is mostly 120 Hz that you hear [6].

Perhaps this is a good introduction to the fact that audio recording is, even in uncomplicated cases, hard to do and is both engineering and art. Why so hard. You sit down in a living room and converse quite easily. Isn't making an audio recording just a matter of placing a microphone where YOU are? Well, watch an array of talking heads on TV and you will see them all individually miked. The ear is a far far better receiver and the ear/brain uses directional cues to concentrate on the sound. A microphone is just a point receiver.

So we need to be aware that recording/analyzing an audio signal is already a difficult task, and it gets harder and harder at low frequencies and low amplitudes. And many audio recorders today (such as cell phones) just do not get anywhere close to those frequencies – they aren't supposed to. If you hear something, don't assume you can record it. It is no wonder that many purported recordings of the Hum come back blank. It is also clear that some recordings that claim to be (at least) anomalous sounds are not the Hum, although better recording attempts! Most or perhaps all recordings of the Hum are poorly documented as far as I have found.

In fact, it is interesting to consider if a useful recording can even be made. If the Hum is not acoustic, an audio recording cannot even be done. And, when people who are included among the "hearers" are asked to vet a recording as being the Hum (who else could do it?), they need to have the playback blocked at times [3, Fig. 1] in order to make sure they are not "making up" a Hum on the spot, superimposed on anything the recording contains. Yet another question is: given that not everyone hears the hum (few do?) would non-hearers hear even a proper recording?

Conclusion: (2) Recording/analyzing a purported instance of the Hum, with everyday equipment, is extremely problematic. At the same time, the confounding of such attempts by numerous real problems is understandable and expected.

(3) ELECTRONIC DETECTION – RECORDING/ANALYSIS

As said just above, it is very very difficult to record and display the Hum. If it is the case that there is no acoustic (physical vibration) causing the Hum, it would of course be impossible to record and analyze that which does not exist.

Two points need to be made right here. First, any claim here that the Hum does not exist acoustically does not imply that the phenomenon of an apparent perception does not exist. It is hard to come up with a useful term, but "illusion" or "hallucination" (not suggesting any individual fault) is the general idea. The term "illusion" to me suggests a trick (a magician's honest performance) or possibly a demonstration of a principle of perception. Both optical and auditory illusions are common. The term "hallucination" often had a pejorative implication! Here we have in mind an auditory hallucination comparable to what visually might be a mirage, or the "phosphenes" most of us see as colored blotches as we fall asleep in a dark room. Nothing usual or faulty.

The second upfront point is that scientifically valid experiments are difficult. We envision, perhaps, a definitively drawn test of an idea that should give Result A or Result B. However, not unusually, you get Result C which amounts to an ambiguous A, B, or something else. A refinement to the original experiment is necessary, and perhaps a redefined methodology. It is usually wise and often necessary to take cautious steps, repeating, analyzing, and reflecting on what, if anything, is determined with certainty.

Here our goal is to capture and display any real time-domain waveform. Because of random noise and fluctuating conditions, any actual oscilloscope traces are expected to jump about. There are three ways to try to avoid this. The first is to use a sampling scope (digital storage oscilloscope) so that the time waveform can be captured and displayed. Sounds great, but it can lead to the accumulation of immense amounts of data, and often conflicting data. A second approach is to attempt to remove random noise by averaging, but this assumes that the signal is persistent enough and the noise is random enough that the two separate. This doesn't always happen - an average picket fence is a solid fence. The third approach is the seeming magic bullet of jumping to the frequency domain (using a Fourier Transform, usually the FFT [7]). Because people often have a less than comprehensive understanding of Fourier analysis, they suppose that somehow, ambiguities are thereby resolved. A frequency-domain display of a flawed time-domain signal is generally unrevealing, or misleading. In consequence, if you see something in the time domain, it could turn out somewhat better or somewhat worse in frequency. But it won't be immensely better. The FFT is not a panacea.

Previous Webnotes [3-5] have provided technical data on attempts to observe a physical (acoustic – vibration of air molecules) counterpart to a Hum perception. These have shown that there is no acoustic findings relating to the Hum – at least not in the experiments documented. Here is a brief summary review.

(3a) A direct recording shows no obvious acoustic counterpart. This was shown in [3, Figure (3)] and in [4, Figure(3)], although there was considerable evidence of power-line noise at 60 Hz and more particularly, at 120 Hz. In [4] we described in detail how the power-line noise could be greatly reduced (perhaps virtually eliminated) and we showed [4, Fig. 3 and Fig 4] that (3b) with the power-line noise notched out, nothing resembling the expected Hum, particularly nothing suggesting a non-random background, was found. Finally in [5] we showed a necessary "control" where we asked if an artificially generated signal (chosen at 50 Hz) set loud enough to compare to the Hum should have been recorded. (3c) The conclusion was that not only should it have been picked up, but with relative ease.

(4) EVIDENCE FROM LOCATIONS IN PLACE AND TIME

Glen MacPherson has maintained a site [8] with immense amounts of data on the folks who "hear" the Hum, as well as a very interesting "Research Forum" for which he deserves highest marks. Although there is probably too much data for him or anyone to analyze (not to mention refine and update), two conclusions seem clear and have been noted. First, the "hearers: are concentrated in the technically advanced (and media permeated) parts of the world (US, Europe, Canada, Australia, Brazil). Secondly, in terms of time, people started reporting the Hum from a time roughly 30 years ago.

As to the geographic distribution, it is not too surprising that it is the way it is. People have registered on Glen's website because they had the computer, and the spare time. and were exposed to what we might call a "meme" of the hum. This means that certain areas of the world are favored to enter from a computer as a matter of daily entertainment, while others lack resources and have more urgent concerns. [An old proverb says that when you have food on the table, you have many problems, but when there is no food on the table, you have only one problem.] So there is not much that is unexpected there. On the other hand, if we were to assume that the cause of the Hum were a central source radiating (radio or even acoustic), or even several sources, we would normally expect, on physical grounds, certain patterns of receptors. Perhaps there could be such mapped patterns but only "lit up" in certain areas of a high density of possible hearers. But there is no such evidence at hand. (4a) The distribution of "hearers" is counter indicative of a central, radiating source for the Hum.

The distribution of time of (first) occurrence is less easily examined. "When did you first begin to hear the Hum?" would seem like a clear question. It's not. In the first place, if we are to believe the statistic (to which I do not give much credence) that only between 2% and 10% of the population hears the Hum, then most people should answer "Never". Secondly, even if a consensus date were possible, showing that a corresponding (probably technological) event was causally related would be extremely difficult. Thirdly, the circumstances surrounding the first hearing are extremely important and seldom (if ever) compiled. (Did you just hear it all by yourself late one evening; or did someone ask if you heard a hum, or did you read about it, and then hear it?)

With regard to saying when the Hum started, we work from ignorance and a general inability to obtain (let alone verify) useful data. If the first hearing were credibly relatable to some plausible causative event (perhaps turning on a transmitter), that would be important, and possibly would rule out any "internal" explanations. But the data is very poor. (4b) With regard to the interpretation of evidence from "first hearing" we suffer from extremely poor data, small samples, and a lack of compilations of surrounding circumstances, making the data of less value than one might otherwise suppose.

(5) THE "DEMING" (Blocking) BOX

Glen's efforts have involved, quite famously, a "Blocking Box" which he named a "Deming Box" after U. Oklahoma Professor David Deming who in 2004 [9] suggested a metal box (person inside!) as a means of excluding RF that might be the source of a radiated Hum (with the RF somehow transduced to an audio perception). This notion of a possible Very Low Frequency (VLF, or even Extremely LF) radio transmitter has been around for year, presumably being a transmitter located in the upper Midwest with an immense antenna miles in size, transmitting megawatts, and intended to send information to military submarines underwater. Or some such notion.

As suggested above, this would seem to generate a locally strong cluster of hearers, even if received by subs worldwide. Or if it were airborne, it would have limited power (a flying generator) and a smaller antenna. The whole idea of a VLF transmitter is highly speculative but would seem to have the great advantage of being a testable hypothesis. You just use something to block RF from the hearer.

This is perhaps an extended presentation of the "tin-foil hat" gag! It is well understood (physics) that a metal of thickness much greater than just foil would be needed to block VLF RF signals (although, not to block microwaves). Deming in fact suggested a controlled experiment of three "coffin sized" boxes, one blocking sound, one of metal blocking RF, and one neutral. Kind of hard to do a blind experiment, but with care, possibly a useful finding would emerge.

I really am not a fan of an individual such as Glen doing this experiment by himself, and have said so on his site. The issue is safety. Hence above I did not hesitate to use the uncomfortable term "coffin" to describe the box, which is what the actual construction resembles. His description of the box is RF tight and in fact airtight. You can go into that box for a few minutes. Of course you don't intend to stay inside very long. On the other hand, in order to determine if the Hum is heard or not, you probably have to get comfortable. For reasons of getting sufficiently comfortable, not to mention personal safety concerns, you really have to have a comrade outside the box, with a good timer, and with strict orders to open the box and insist that you get out after a few minutes.

As of this writing, Glen reports being inside the box once, and he was criticized for waiting so long for his first attempt, and it is apparently unclear to many why he does not aggressively pursue the experiment. First I would note (see second "upfront" comment in Section (3) above) that the experiment was difficult to do and evaluate. Glen as a scientist knew that due care must be taken to get proper results. One test would not likely get you a firm result. Second, just what constitutes a definitive, reportable result?

It might seem that one would hear the Hum outside the box, climb inside and not hear it, and be convinced that the box is blocking the signal (VLF-RF apparently in this case). In reality, he had to deal with the conditions he found. The largely outside environment made it unclear if he was hearing the Hum outside the box to start with. Getting in the box is then a new experience. If he does not hear the Hum, is he more sure it was not there now, or was it originally ambiguous outside anyway. (5a) To be sure of the negative finding (meaning – Hum is heard, not blocked), statistically, several or many good replications are necessary. If achieved, you perhaps can say at best that being in a box makes it hard to hear the Hum. (It could be that in-box resonances effect what you expect, or that you can't get comfortable in the enclosure.) Optimistically, perhaps you really are blocking a real RF instigator of the Hum. Likely your results should prove useful. Good experiment so far.

More simply, and definitively, if you clearly hear the Hum while inside the box, even just once, this is very meaningful. (5b) In the case of hearing the Hum inside the box, either the box does not block an external signal (RF, acoustic, or ?), or the Hum is generated within yourself. This would be very significant. Great experiment.

I rather expect the normal Hum experience will be heard inside the box.

(6) EVIDENCE OF INTERNAL CAUSE

We all know the two aphorisms "You can't prove a negative" and "Absence of evidence is not evidence of absence." The first depends on what "prove" means, and the second is just wrong! It's nonsense. If you have been diligent in looking for

something (made a proper effort) and not found it, it IS evidence (not proof of course) that that thing is not there. Here, having made a careful study looking for an acoustic counterpart of the Hum, and not finding it, we take this as evidence for no such acoustic signal (and likely not an electric or magnetic one – see wire and transformer tests [2]). This was an experiment that required some special knowledge and equipment.

A second significant finding of internal generation was the "grunt" effort, actually a more difficult experiment to do and evaluate, but one looking for a positive result: the Hum does very briefly pause when the "hearer" grunts. No special knowledge or equipment, but requires careful attention to the details of what you are perceiving, and doing it enough times to be statistically (intuitively) convincing. At the same time, we have the experiment of sticking fingers in ears as the best likeness of what the Hum sounds like. These two things are more like demonstrations than experiments.

Here with regard to these individual trials, as opposed to the engineering-based measurements, we run into a less objective basis of evaluation, and one for which there is less as a background research pool (that is, a less analytical science, biology, as compared to math and physics). There seems to be very little research by people who are competent in hearing and in signal analysis. We do have some comment by more generalist science practitioners (next paragraph), and we hope the series in these Webnotes is in that spirit.

Deming in 2004 [9] was very comprehensive and objective, but offered nothing by way of finished experiment. He was of the opinion that there was no acoustic Hum, and he felt that internal generation (broadly, tinnitus) was unlikely, leaving him to favor a VLF radio explanation. An older 1995 brief report by Mullins and Kelly [10] did take some equipment readings around Taos, mentioning an internal source as one possibility, but more or less admitted defeat in not finding a real answer. A very long report by Leventhall, *et al* [11] dated 2003 deals in general with low-frequency noise and has a short presentation (Chapter 11, pp 43-45) dealing with the Hum and seems to be going somewhere just when it runs out (but is worth looking at despite the earmarks of a government (UK) report!). This report does suggest the "meme" nature of the phenomenon. As to Glen's site [8] it is largely admirable, and his own work and attitude are sound.

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